

STRIP CROPPING, with alternate strips of tilled and untilled crops, is coming into wider use as a practical method of erosion control on sloping lands. Usually it is done on the contour, but this may be modified to suit conditions. This article shows the beneficial results of the practice, gives directions for laying out the strips, and touches on the place of strip cropping in the farm rotation.

Strip Cropping

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ACCORDING to estimates made by the Soil Conservation Service in each of the States and checked by State colleges, experiment stations, and other agencies in the States working on the land-use problem, about 61 percent, or 252,363,100 acres, of the cultivated land of the United States is sufficiently rolling to cause runoff of rain water and erosion when not protected by vegetation.

Strip cropping is one of the practices recommended for erosion control and soil conservation that has a wide potential application on this area. Every farmer producing diversified crops has the choice of growing these crops in blocks in large fields or of dividing the fields into relatively narrow strips so that each clean-tilled strip will be protected by a noncultivated strip of small grain, hay, or grass.

The reason for this practice is obvious. When large fields or blocks of sloping land are plowed and cultivated at one time, as has been common practice in the past, they are subjected to maximum erosion for long periods until vegetation is reestablished. In contrast to this wasteful practice, large fields and long slopes can be protected against erosion by plowing and cultivating alternate strips, always leaving protection strips of erosion-resistant crops between the clean-tilled areas. The strips can be farmed in rotation and in combination with other soil conservation practices where necessary, just as fields can be.

There are three types of strip cropping commonly used in the United States—contour strip cropping, field strip cropping, and wind strip cropping.

CONTOUR STRIP CROPPING

Contour strip cropping is the production of the ordinary farm crops in long, relatively narrow strips of variable width, on which dense ero-

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sion-control crops alternate with clean-tilled or erosion-permitting crops (fig. 1), placed crosswise of the line of slope, approximately on the contour. While it is desirable to follow the true contour, it is not always possible to have parallel strips with all the rows of a given strip exactly on the level, because of variations in the slope of the land. It has been found in practice that if the soil is fairly permeable and the rows deviate from the contour only slightly, usually not over 2 percent, and then for only 100 feet or less, this deviation will cause no serious erosion.

FIELD STRIP CROPPING

Where the soil is absorbent and where it would be impracticable to follow the true contour, a modified form of contour strip cropping is



FIGURE 1.—Contour strips of corn alternating with close-growing vegetation reduce run-off and prevent accelerated erosion.

sometimes employed on uniform slopes or on land that is undulating with no definitely defined slopes. This is referred to as field strip cropping.

Field strip cropping is the production of the regular farm crops in more or less uniform parallel strips (fig. 2), laid out crosswise of the general slope, but not parallel to the true contour. Field strip cropping, unless applied to very regular slopes, is a poor substitute for contour strip cropping, but it is usually a step in the right direction and is far superior to exposing to erosion at one time entire fields with long slopes. If these straight strips cross low areas or natural depressions the rows of cultivated crops thus thrown off the contour will accumulate run-off that will cause erosion unless the waterway is protected with permanent vegetation. Waterways in grass or other vege-

tation (fig. 3) increase the effectiveness of field strip cropping and permit its application to larger areas.

WIND STRIP CROPPING

Wind strip cropping is the production of the regular farm crops in long, relatively narrow, straight, parallel strips placed crosswise of the prevailing wind without regard to the contour of the land. Wind strip cropping, which is applicable to limited areas, may be slightly more effective in retarding wind erosion than contour strip cropping, but usually has little value in conserving water. For this reason, the advantages of each type should be carefully weighed. The increased vegetative growth resulting from the moisture saved with



FIGURE 2.—Field strip cropping. Strips laid out parallel, of uniform width, and crosswise of the slope can be used to advantage on uniform slopes.

contour strips may make them more desirable than strips designed to resist only wind.

STRIP CROPPING A FORM OF VEGETATIVE CONTROL

Strip cropping, regardless of the type, is purely a vegetative control of water, wind, and soil, and its effectiveness is dependent on the production of an adequate cover of the right kind of vegetation to offer resistance to wind or water. No better measures to control erosion have been devised by man than those found under natural conditions. Among these natural measures, grass is probably the most effective. Lands covered by a natural, heavy sod of grass suffer no serious run-off or loss of valuable topsoils in seasons of normal rainfall.

It is now definitely known that, other things being equal, the longer the slope or the larger the area from which water accumulates, the greater the danger of erosion. The average farm should have, in combination with other soil-conserving devices, a sufficient acreage of erosion-resistant and soil-building crops, sown in long strips, to break up large fields and at all times protect the clean-tilled areas.

Not all of the close-growing, erosion-resistant farm crops are as efficient as grass, but the small grains and most of the legumes and other hay crops are good substitutes and usually can be utilized effectively. Advantage should be taken of the erosion-resistant crops best adapted to the locality when planning a strip-cropping system.



FIGURE 3.—Rearrangement of fields by removing fences often makes it possible to have long level rows of cultivated crops, which can be produced much more economically than short rows. Note the two natural waterways in the foreground protected by permanent grass.

Observations made on nearly a million acres of land strip cropped under various conditions indicate that the practice when properly planned is very effective in conserving soil and water.

Limited experiments with strip cropping conducted by some of the Soil Conservation Service experiment stations tend to substantiate these conclusions. At the Temple, Tex., station (table 1), it was found that for the period 1932-36 the plot that was strip cropped lost less than 1 percent of the rain as run-off and less than 4 tons of soil per acre, as against nearly 7 percent of the total rain and about 39 tons of soil per acre for cotton planted on the contour; and almost

16 percent of the rainfall and more than 89 tons of soil for cotton rows up and down the hill. Sixteen times more water and soil were lost under rows up and down the slope than under strip cropping.

Table 1.—Water and soil losses under strip cropping and other methods of cultivation of cotton on black Houston clay, Temple, Tex., 1932–36¹

Cropping condition	Plot size		Water loss		Soil loss per acre
	Area	Length	Depth	Percentage of rainfall	
	<i>Acres</i>	<i>Feet</i>	<i>Inches</i>	<i>Percent</i>	<i>Tons</i>
Strip cropping cotton and control crop ²	0.0463	168	1.546	0.95	3.362
Cotton on contour.....	.0847	168	11.048	6.81	38.96
Cotton, rows down slope.....	.0309	168	25.364	15.63	89.07

¹ Average annual rainfall, 34.78 inches; average slope, 3½ percent.

² 24-foot strips Nos. 1 and 4 control; rotation, redtop cane, Sudan grass, oats, and vetch. Strips Nos. 2, 3, 5, and 6, cotton planted on contour.

The run-off and soil loss resulting from one rain of almost 5 inches that occurred at this same station on July 4 and 5, 1936, are given in table 2. During this rain the strip-cropped plots lost only 5.4 percent of the water and 269 pounds of soil per acre, while the plots with rows of cotton up and down the hill lost 64.2 percent of the water and 33,032 pounds of soil per acre.

Table 2.—Water and soil losses under strip cropping and other methods of cultivation of cotton on black Houston clay, 3½-percent slope, Temple, Tex., after a storm, July 4 and 5, 1936¹

Plot No.	Cropping condition	Length of plot	Water loss		Soil loss per acre	Crop residue
			Depth	Percentage of rainfall		
		<i>Feet</i>	<i>Acres-inches</i>	<i>Percent</i>	<i>Pounds</i>	
12	Strip cropping—contour cotton and redtop cane.....	168	0.269	5.4	269	Vetch.
13	Cotton on contour.....	168	2.481	49.8	23,905	None.
14	Cotton, rows down.....	168	3.199	64.2	33,032	Do.
15	Strip cropping—contour cotton and oat stubble.....	168	1.175	23.6	992	Sudan grass stubble.
16	Strip cropping—contour cotton and Sudan grass.....	168	.718	14.42	307	Vetch.

¹ Total rainfall, 4.98 inches; maximum intensity, 1.20 inches per hour for a 5-minute period; 0.16 inch for 1 hour.

At Guthrie, Okla., on Vernon fine sandy loam soil with a 3- to 4.5-percent slope, similar results were obtained by the Soil Conservation Experiment Station, although they were not quite so extreme. For the period from March 1934 to December 1936, strip-cropped plots lost much less soil than continuous cotton planted on the contour. The data are shown in table 3.

Table 3.—*Water and soil losses under strip cropping and other methods of cultivation of cotton on Vernon fine sandy loam, Guthrie, Okla., March 1934 to December 1936*¹

Plot No.	Cropping condition ²	Slope	Water loss		Soil loss per acre
			Depth	Percentage of rainfall	
		Percent	Acre-inches	Percent	Tons
1	Cotton on contour, alfalfa control strip	4.50	4.117	4.69	1.459
2	Cotton on contour, alfalfa and Sudan grass control strip ..	4.00	11.527	13.47	4.762
3	Continuous cotton on contour	3.50	9.778	11.96	8.265
4	42 feet oats-Sudan grass control, 63 feet cotton on contour ..	3.00	9.717	11.09	4.901

¹Total rainfall, 83.61 inches; size of plots, 1 acre—128 by 340.3 feet.

²All cotton followed by a wheat cover crop. Plot 1, 12 rows of cotton to 1 strip and slightly narrower control strips. Plot 2, 12 rows of cotton to 1 strip and slightly wider control strips.

While experimental results are not yet available for all types of soil, degrees of slope, and combinations of crops, indications are that on fertile ungullied soil contour strip cropping can be used effectively on practically all sloping land devoted to the production of clean-tilled crops.

ADVANTAGES OF STRIP CROPPING

Strip cropping, combined with contour tillage, crop rotations, winter cover crops, diversion ditches, and terracing where necessary, has been proved by both experiment stations and demonstration farmers to be very economical and effective and one of the most practical means of conserving soil and water on cultivated land.

Contour strip cropping divides the length of the slope, checks the momentum of run-off water, filters out the soil being carried off, and increases the absorption of rain water by the soil. This is accomplished by the multitude of obstructions offered by the dense, close-growing crops in alternate strips, which by slowing down the rapid flow of water cause it to spread and soak into the soil.

Root growth and earthworms open pores or tiny tunnels in the soil and the dense vegetation on the control strips prevents them from being sealed by silt. This condition permits greater absorption of water by the soil. The filtering action of the control strips is very important, as muddy water laden with sand and silt is more erosive than clear water because of its higher specific gravity and because the sand and other soil particles moved by the water produce an abrasive action.

Strip cropping by providing a larger number of small fields encourages the use of a proper crop rotation and helps maintain a balance of soil-building and harvested crops. It can be installed at practically no expense and the cost of maintenance is very low. The strips do not require the same degree of engineering exactness and accuracy in their installation as do terraces, because a slight error can easily be corrected the next time the strip is plowed.

Strip cropping with rows on the contour not only conserves soil and water but also time and energy. Less time is required to cultivate

a given area in long rows than in short rows because of the fewer turns, and contour rows can usually be made longer than rows in the square fenced field. Often two or more fields can be thrown together, thus making longer rows and sometimes saving fence. In tractor operations on the contour, time is saved by not having to stop to change gears in going up and down hill. By keeping the strips and rows on the level, less power is required, an important item on some farms.

Reducing the run-off by strip cropping prevents the loss of plant food applied in the form of fertilizer, manure, or crop residue, and is thus reflected in crop yields (fig. 4).

Strip cropping, in conjunction with contour tillage and terraces (fig. 5), increases the efficiency and safety of the terrace system by



FIGURE 4.—Crops grown in contour strips make good use of the extra moisture and plant food that is trapped and prevented from clogging the drainage channels.

being a secondary defense in emergencies and by helping to prevent overtopping, channel silting, or ridge washing. It also facilitates terrace maintenance by distributing the farmer's work over the farm so that he can frequently observe and repair any defects before they become large and destructive. Much of the destroyed and abandoned land is the result of failure to observe and promptly repair the apparently harmless little rill or finger gully.

While strip cropping alone will not completely control erosion on all soils and slopes, it has so many advantages over the old system of plowing, cultivating, and otherwise subjecting the entire areas of large fields to erosion and consequent loss of soil and water, that it merits careful consideration and adoption by every crop farmer operat-

ing land subject to erosion who is interested in improving or maintaining the permanent productiveness of his farm.

LAYING OUT STRIPS

It is difficult to state rules that will apply to all conditions in planning and laying out a strip-cropping system. A few fundamental suggestions, however, are applicable to any condition. In the first place, one must have the courage to rearrange his farm completely if need be. This may mean relocating fences to change the field arrangement, taking some steeper slopes out of cultivation and retiring them to pasture or trees, taking some level pasture lands that are suitable for cultivation out of pasture, and adjusting rotations to meet the variations in erodibility of the soil. Practical, sound soil conservation must be the first consideration, and it may therefore be necessary on



FIGURE 5.—Terraces and contour tillage are strong allies of strip cropping in preventing erosion and conserving moisture.

some farms to change the farming system or land use to fit these soil-conserving methods.

In laying out a strip-cropping system one should first consider the approximate difficulty with which erosion can be controlled in order to determine intelligently the width and location of the strips. This requires careful consideration of existing conditions, such as variations in relief that will determine whether or not the strips can be uniform in width with parallel boundaries or vary in width with irregular boundaries; points where run-off concentrates, so that provision can be made for safely conducting accumulated water off the field; amount and distribution of run-off water flowing across this field from the drainage area above; length of slope on which run-off can accumulate; present moisture-retaining condition of the soil; soil type, such as

sandy loam or clay; crops used in the rotation that will provide both clean-tilled and dense-growing vegetation; and the type of machinery used in the production of these crops.

While no specific rules can be given for laying out a strip-cropping system that will apply to every farm, a general knowledge of the function of the strips in breaking up the length of erodible slopes or clean-tilled areas will usually suffice. Long, steep, impervious slopes will naturally require a much larger proportion of close-growing,

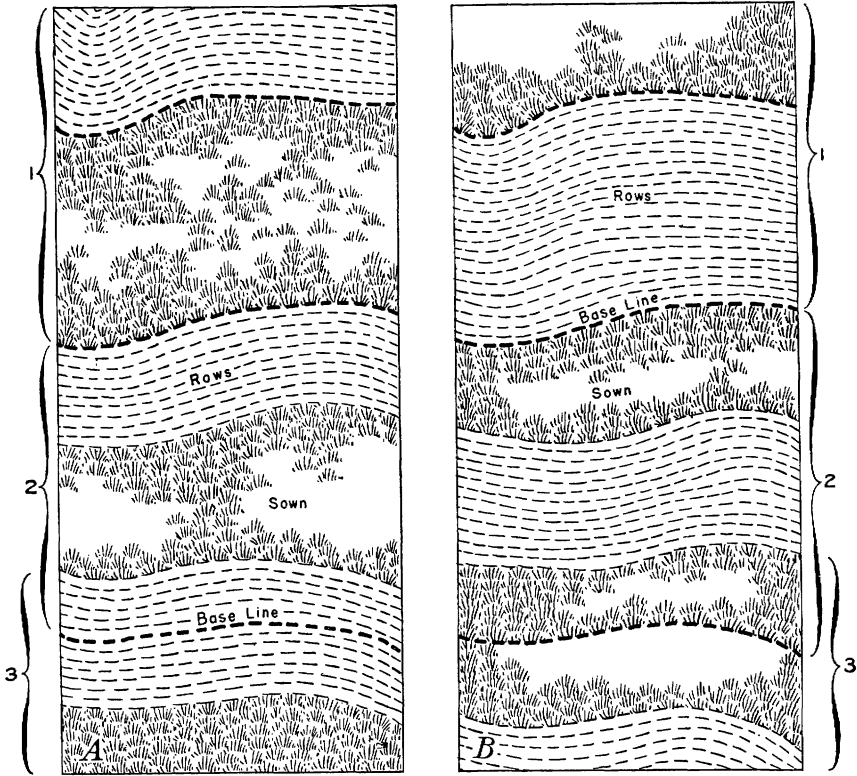


FIGURE 6.—Three methods of using the base line in laying out strip crops. The strips may be measured either (1) above or (2) below the base line, or they may straddle it (3). This diagram also illustrates how crops can be rotated in a strip-cropping system. Row crop areas will be seeded one year to close-growing crops (A), and the next year these strips may be plowed for row crops (B).

erosion-resistant crops than short, gentle, pervious slopes. This condition will vary under field conditions from slopes that are so difficult to control that row crops are never justified, to slopes that can be safely farmed in fairly wide strips of row crops alternating with equally wide or narrower strips of close-growing crops. If a soils map of the farm is available, it is worth while to study the soil type, degree or amount of erosion that has already taken place on that field, percentage of slope, drainageways, and land cover, before laying

out the strips. This information should be very helpful in establishing a base line or starting point for the first strip to be laid out.

The base line may be established by various methods but must be on the true contour and so located that as many strips as possible may be measured from it both up and down the slope. On irregular slopes the base lines will need to be closer together than on regular slopes. There are three ways of using the base line (fig. 6). It may form either the top or the bottom boundary of the strip, or it may be used for the center line.

The boundaries of the strip may be measured from the base line with a tape measure carried by two men, one walking on the base line and the other at the desired distance from the base at the other end of the tight tapeline, which must be carried at right angles to the base. Stakes can be set 50 or 100 feet apart by the man who is staking the strip boundary. Immediately after the boundaries have been staked they should be more permanently established by plowing a light furrow.

Any comparatively accurate method may be used in establishing base or contour lines, but the eye alone is not sufficiently accurate. For ordinary slopes any of the simple levels such as the Abney, Locke, line level, or common level will be satisfactory. On long, relatively uniform contours, a tripod level is advantageous because the greater range of the telescope will save time. Strips should be laid out when the work will least interfere with growing crops. It may not be possible to bring an entire farm under a strip-cropping plan the first year, on account of disrupting the rotation, but usually 2 or 3 years is sufficient time in which to bring every cultivated field into the system.

After establishing the base or contour line the next problem is to determine the width of the strips. Usually, as previously stated, the longer the slope the greater the erosion, but in the effort to break the length of slope by strip cropping, strips should not be so narrow as to be impractical. In general the width of the strips will depend on several factors, including type of soil, percentage of slope, length of slope, amount of normal rainfall, kind of crops, rotation, use of cover crops, amount of soil humus, degree of erosion, and, to some extent, type of farming followed. The relation of these factors to strip cropping has previously been discussed. As a very general guide, strips under the most favorable conditions should rarely, if ever, be more than 200 feet in width and in order to be practical should seldom be less than 50 feet in width. The kind, amount, and density of the vegetation used in the control strips is another factor in determining width. On soils of low fertility that will produce only scant vegetation, or where gullies have started to form, control strips will not be so effective and should in such cases be reinforced with terraces. Too much should not be expected of strip cropping in its early stages until the strips become well established and the soil fertility has been improved so that thrifty, dense vegetation can be produced.

In order to see this practice in the field, it is suggested that farmers interested in laying out a strip-cropping system for their own farm visit one of the Soil Conservation Service demonstration areas. Almost 1,000,000 acres have been laid out by the Service in strips of

various widths and on all kinds of soils and slopes. A solution to many problems may be found on these areas.

Laying out a strip-cropping system on terraced land is relatively simple because the contours are permanently marked by the terraces and the width of the strips can be adjusted to the terrace interval. There are several methods of locating the strips on terraced fields. They can be placed on the terrace interval, from terrace ridge to terrace ridge, or they can straddle the terraces, with modifications to suit the conditions. Strips astride the terrace divide the terrace interval and are more effective in reducing erosion. They also facilitate terrace maintenance and admit of the maximum number of full-length parallel rows. Where terraces are not parallel, the irregular areas can be occupied by close-growing, noncultivated crops.

Border strips or turn strips are often utilized to advantage in producing hay and as an aid in the cultivation or harvesting of other crops. They also serve as roadways connecting the various strips so that each strip is easily accessible for the different tillage and harvesting operations. Irregularities of slope or relief make it impossible to have all strips parallel and of uniform width; therefore, provision should be made to reach each area without driving through unharvested crops or up and down the slope over unprotected land. Border strips make this possible.

Irregularities of relief also make it impossible to have all rows laid off parallel to the established base line or terrace strictly on the true contour. This makes it necessary either to have point rows or to keep the rows parallel and permit some deviation from the contour. The amount of deviation from the true contour that can be permitted will depend on the type of soil and a number of other factors, but field trial will be the best guide, and if it is found that some rows have too much slope and are causing erosion, the error can be corrected the next time the strip is planted to row crops. Generally, under favorable conditions, this deviation from the true contour should not exceed 2 percent (2 feet of fall in 100 feet of horizontal distance), and then for only short distances. If strips cannot be laid out sufficiently straight to be practical without deviating 2 percent or more from the true contour, then the low areas where water accumulates should be protected by establishing permanent grassed waterways. These are discussed in the article, *Mechanical Measures of Erosion Control*. After several years' farming, the sediment collected by the vegetation in the waterways may fill them sufficiently to reestablish the true contour.

STRIP CROPPING AND ROTATION

Producing the ordinary farm crops in long, level strips instead of in large fields that necessitate operating up and down hill is one of the simple, easily adopted, yet very effective soil- and moisture-conservation measures. It should be combined with other good farming practices so that the soil can be permanently maintained in a highly productive state. The soil should be occupied either by a crop for harvest or by a protective cover crop to be returned to enrich the soil. Crops should be rotated in the strip system, as well as in the old large-field system.

In planning the rotation, there may be some critical slopes that cannot adequately be protected with the ordinary annually rotated crops. These should be taken out of the regular rotation and protected by seeding to perennial vegetation, such as alfalfa-grass mixtures, kudzu, or perennial lespedeza, that will give permanent protection to both the critical slope and the areas above and below the slope. These perennial strips can be a part of the strip-cropping system even though they may not be a part of the regular rotation. The need for this special protection is evident all over the country. When the fields are bare and thin, light-colored areas where the productive topsoil has been washed off can be seen in many fields; and when covered by crops, sickly green, scant vegetation marks the spot.

Good rich soils produce profitable crops, while thin, eroded soils produce unprofitable crops. Strip cropping, if employed on the sloping agricultural areas of the United States, will help keep the soil permanently productive and profitable.